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Safety Assessment of Airport Collaborative Decision Making (A-CDM)

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Abstract

This document presents a safety assessment of the Airport CDM (A-CDM) Project. The relevant A-CDM milestones, flight phases and data flows have been systematically analysed. The safety impacts of A-CDM have been identified and documented. Where concerns or new hazards have been found, appropriate risk mitigation has been proposed.

Keywords

Airport CDM (A-CDM)
Safety Assessment
Risk Mitigation

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EXECUTIVE SUMMARY

Objectives and Method

This document presents the safety assessment for the Airport Collaborative Decision Making (A-CDM) project. Safety assessments have been prepared in parallel for Airside Capacity Enhancement (ACE) and Runway Safety (RWY SAF). The objectives of this safety assessment are to:

1. Identify the operational differences between pre and post A-CDM operations for all partners and all flight phases associated with airport operations.
2. Assess the safety impact (positive and negative) of the differences identified for all A-CDM partners under normal operating conditions (Success Case) and failure conditions (Failure Case).
3. For safety concerns and hazards identified in 2), identify mitigations to ensure that A-CDM will maintain or improve safety.

The safety assessment approach consisted of the following steps:

- The A-CDM system was defined based on the Operational Concept Document (OCD) and the Functional Requirements Document (FRD). In particular the Milestones (MST) underpinning the A-CDM concept, the Functional Groups (FG) and the data flows/ items were defined. It is recognised that the pre-CDM situation could vary significantly between airports and between airport partners. For this study a pre-CDM situation has been defined which lacks the elements and FGs described in the OCD and FRD. Thus the safety impact described in this report may be greater than that experienced by airport partners which already have some parts of CDM in operation.
- The safety impacts of A-CDM were analysed assuming that the A-CDM system was operating as described in the OCD and FRD. This is termed the “Success Case”. For each Milestone and relevant flight phase, A-CDM was compared with the pre-CDM situation from the viewpoint of each airport partner.
- Potential issues and concerns and new hazards associated with failures of the A-CDM system were also analysed (termed the “Failure Case”). For each data item identified in the A-CDM documentation the flow of information between source and recipient was identified. The potential worst credible effects of loss or corruption of this information were then identified.

The outputs of this generic analysis, in terms of safety impacts and mitigations, will be sensitive to local airport conditions. Therefore local safety assessments (as required by ESARR4) will need to review these outputs and update them for their local airport situation. Guidance on conducting such local assessment has been provided in this report.

Conclusions

This generic safety assessment concludes that A-CDM will lead to no adverse safety impacts with the mitigations identified in this report.

A very limited number of potential safety concerns have been identified. The Success Case issues would be adequately mitigated by practicable procedural and Safety Management System (SMS) recommendations which have been proposed. In particular clear definitions of roles and responsibilities are required to ensure that all relevant personnel understand

how A-CDM information is to be used. The Failure Case issues are mostly adequately mitigated by practicable procedural recommendations. In addition, there may be a need for some system equipment requirements (e.g. Software Assurance Level) for certain data items within A-CDM. An initial set of key data items has been identified in this generic study which local assessments would need to check to determine if system equipment requirements are needed, or whether failure effects are adequately mitigated by other means.

ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
A-CDM	Airport Collaborative Decision Making
ACE	Airport Capacity Enhancement
ACIS(P)	Airport CDM Information Sharing (Platform)
AMAN	Arrival Manager
ANSP	Air Navigation Service Provider
AO	Aircraft Operator
APR	Airport Operations Programme
A-SMGCS	Advanced Surface Movement Guidance and Control Systems
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
CFMU	Central Flow Management Unit
COTS	Commercial Off The Shelf
CSA	Common Situational Awareness
CTOT	Calculated Take-off Time
DAP/SSH	Directorate ATM Programmes/ Safety, Security, Human Factors
DMAN	Departure Manager
EATM	European Air Traffic Management
EATMP	European Air Traffic Management Programme
ECAC	European Civil Aviation Conference
EOBT	Estimated Off Block Time
ESARR	EUROCONTROL Safety Regulatory Requirement
ETOT	Estimated Take Off Time
EXOT	Estimated Taxi Out Time
FG	Functional Group
FHA	Functional Hazard Assessment
FIR	Flight Information Region
FRD	Functional Requirements Document
FUM	Flight Update Message
HMI	Human Machine Interface
HWAL	Hardware Assurance Level
ICAO	International Civil Aviation Organization
MST	Milestone
OCD	Operational Concept Document
PSSA	Preliminary System Safety Assessment
RT	Radio Telephony
RWY SAF	Runway Safety Project
SAM	Safety Assessment Methodology

Abbreviation	Description
SC	Severity Class
SID	Standard Instrument Departure
SLA	Service Level Agreement
SLC	Slot Cancellation Message
SMGCS	Surface Movement Guidance and Control Systems
SMS	Safety Management System
SRM	Slot Revision Message
SWAL	Software Assurance Level
TOBT	Target Off Block Time
TSAT	Target Start-Up Approval Time
TTOT	Target Take Off Time
UI	User Interface
WIP	Work in Progress

CONTENTS

1 INTRODUCTION

1.1 Background

The EATM Airport Operations Programme (APR), maintained by the Airport Operations Domain, consists of the following four projects:

1. Runway Safety Project (RWY SAF)
2. Airside Capacity Enhancement (ACE)
3. Airports Collaborative Decision Making (A-CDM)
4. Advanced Surface Movement Guidance and Control System (A-SMGCS)

The A-SMGCS project has already been the subject of a Safety Case [**1**]. Safety assessments and Preliminary Safety Cases are now being conducted for the three other projects in parallel. This document presents the safety assessment for the A-CDM project.

1.2 Objectives of Safety Assessment

The objectives of this safety assessment are to:

1. Identify the operational differences between pre and post A-CDM operations for all partners and all flight phases associated with airport operations.
2. Assess the safety impact (positive and negative) of the differences identified for all A-CDM partners under normal operating conditions (Success Case) and failure conditions (Failure Case).
3. For safety concerns and hazards identified in 2), identify mitigations to ensure that A-CDM will maintain or improve safety.

1.3 Overview of Safety Assessment Approach

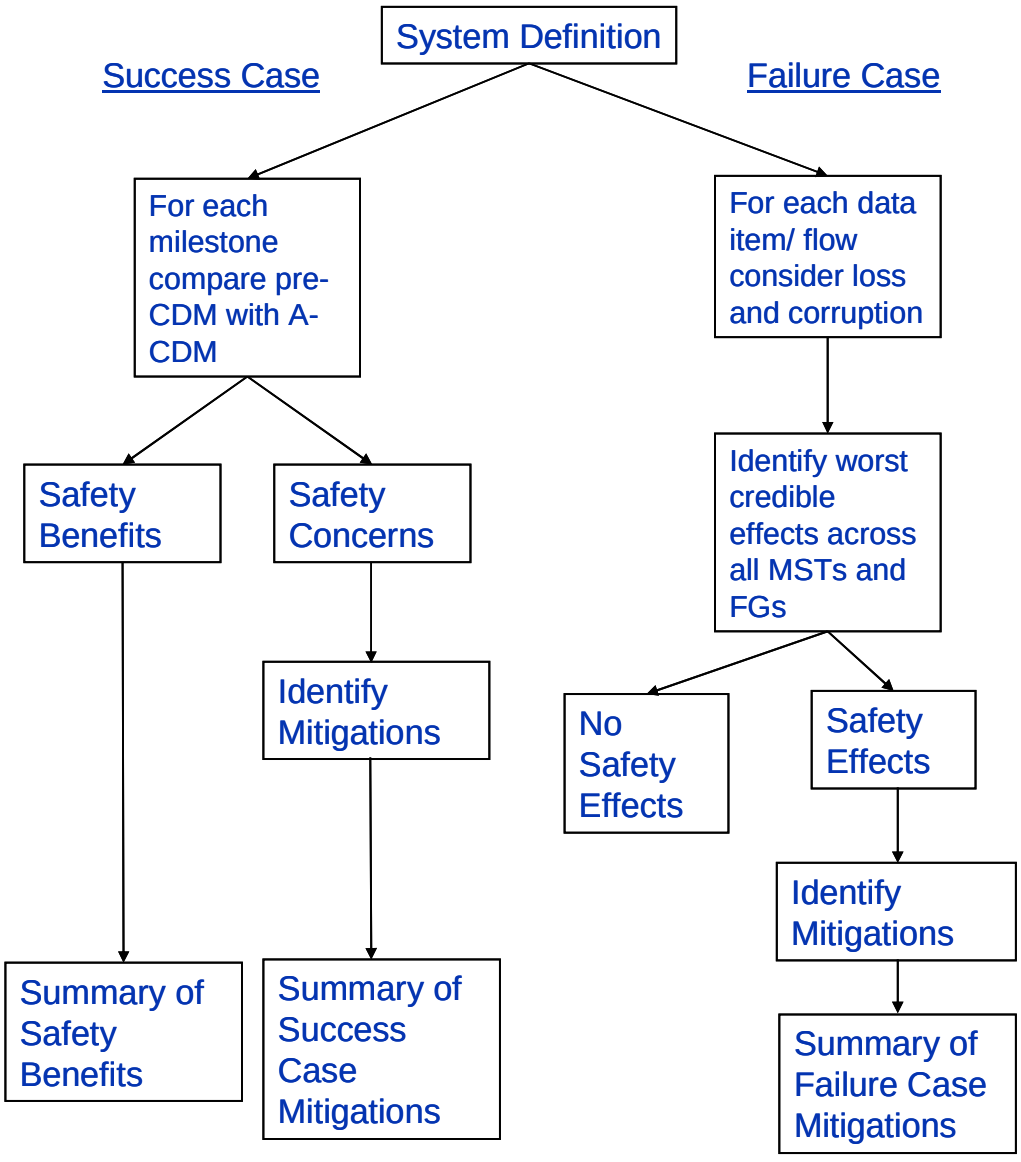
The Safety Assessment Approach is summarised in Figure 1.1 below:

- The A-CDM system was defined based on the Operational Concept Document [**2**] and the Functional Requirements Document [**3**]. In particular the Milestones (MST) underpinning the A-CDM concept, the Functional Groups (FG) and the data flows/ items were defined (Section 2 of this report).
- The safety impacts of A-CDM were analysed assuming that the A-CDM system was operating as described in the OCD and FRD. This is termed the “Success Case”. For each Milestone and relevant flight phase, A-CDM was compared with the pre-CDM situation from the viewpoint of each airport partner (ground handler, airport operator, aircraft operator, ATC, CFMU, etc.). Potential safety benefits of A-CDM were identified and documented. Any potential issues and concerns with A-CDM in its normal operating mode were also identified and appropriate mitigations proposed (Section 3 of this report).
- Potential issues and concerns and new hazards associated with failures of the A-CDM system were also analysed (termed the “Failure Case”). For each data item identified in

the A-CDM documentation the flow of information between source and recipient was identified. The potential worst credible effects of loss or corruption of this information were then identified. In some cases there were no safety effects. For those cases where there could potentially be safety effects, suitable mitigations have been identified and proposed (Section 4 of this report).

- The outputs of this generic analysis, in terms of the safety benefits and mitigations, will be sensitive to local airport conditions. Therefore local safety assessments will need to review these outputs and update them for their local airport situation (see Section 5 of this report).

Figure 1.1 Overview of A-CDM Assessment Approach



Within the safety assessment the following safety criteria have been used (Safety Plan [**4**]):

- Airport risks are not to be increased (consistent with ESARR4 and ATM 2000+); and
- Airport risks are to be further reduced As Far As Reasonably Practicable.

1.4 Document Structure and Relation to Other Documents

This safety assessment report is structured as follows:

- Section 2 provides a system description of the A-CDM project;
- Section 3 presents the Success Case analysis described above;
- Section 4 covers the Failure Case analysis described above;
- Section 5 presents a discussion of the results including how this generic analysis can be used at a local airport level;
- Section 6 summarises the validation and verification activities associated with this safety assessment; and
- Section 7 presents the main conclusions and recommendations.

Appendix I provides the full Success Case and Failure Case analysis broken down by relevant Milestones and airport partners. Appendix II contains a specific analysis of failures of the A-CDM alarms.

Safety assessment reports are being prepared for the ACE and RWY SAF projects in parallel with this document. Three safety case documents will also be prepared for RWY SAF, ACE and A-CDM. As noted above a safety case already exists for A-SMGCS.

1.5 Participants

EUROCONTROL's A-CDM Project has received considerable support from EUROCONTROL's DAP/SSH department and external A-CDM stakeholders in the conduct of this safety assessment. Workshops, post-workshop analysis and reviews of documents have been supported by personnel with a mix of disciplines and expertise including A-CDM designers, ATCOs, Air Navigation Service Providers, aircraft operators and safety experts. This assistance is gratefully acknowledged. Further details of participants in the safety assessment are given in Appendix I.

1.6 Definitions

Mitigation	Steps taken to control or prevent a hazard [or concern] from causing harm and reduce risk to a tolerable or acceptable level (taken from ESARR4)
System	Understood to include equipment, people and procedures

2 SYSTEM DESCRIPTION

2.1 Purpose of the A-CDM Project

Airport Collaborative Decision Making (A-CDM) aims at improving operational efficiency at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources.

Implementation of Airport CDM allows each Airport CDM Partner to optimise their decisions in collaboration with other Airport CDM Partners, knowing their preferences and constraints and the actual and predicted situation.

The decision making by the Airport CDM Partners is facilitated by the sharing of accurate and timely information and by adapted procedures, mechanisms and tools.

Most airport related operational improvement initiatives launched until now were oriented towards improving performance of an individual partner at an airport. However, optimising the capacity of an airport involves interaction amongst all airport partners working as a team. Individual partners must co-ordinate their decisions and activities by sharing information and resources to attain shared goals.

The common goals of A-CDM are as summarised in the diagram below:

Figure 2.1 A-CDM Common Goals

2.2 A-CDM Concept Elements

2.2.1 Overview

The Airport CDM concept is divided into the following Elements [**2**]:

- Airport CDM Information Sharing;
- CDM Turn-round Process – Milestones Approach;
- Variable Taxi Time Calculation;
- Collaborative Management of Flight Updates;
- Collaborative Predeparture Sequence;
- CDM in Adverse Conditions; and
- Advanced Concept Elements

A phased, bottom-up approach is planned for implementation of each element with each implementation step delivering an incremental benefit, which will become even more significant as the CDM Concept Elements mature.

Some of the Airport CDM Elements also serve to create the environment without which other elements cannot work. The Operational Concept therefore assumes that some Elements are implemented before the others are considered, as described in the following sub-sections.

2.2.2 Airport CDM Information Sharing

CDM Information Sharing is essential for achieving common situational awareness (CSA) through the exchange and sharing of all pertinent information, including data recording and post-operational analysis. It also forms the foundation upon which all other Elements operate and as such must be implemented first. This element is supported by Functional Group 0, the User Interface (UI)/ Airport CDM Information Sharing Platform (ACISP) and Functional Group 1, Airport CDM Information Sharing (see FRD [**3**]).

2.2.3 The CDM Turn-round Process (Milestone Approach)

Focusing on the turn-round process and linking flight segments with the CFMU, this Element improves inbound and outbound traffic predictability. Together with CDM Information Sharing, it provides the foundation of the ground traffic network, essential for system-wide planning improvements. This Element is essential if the full potential of CDM Information Sharing is to be realised. It is related to Functional Group 2 [**3**].

2.2.4 Variable Taxi Time Calculation

Variable Taxi Time Calculation aims at improving the accuracy of calculations associated with the ground movement of aircraft, such as estimated take off times. This Element is a pre-requisite for the implementation of the Collaborative Management of Flight Updates. It is related to Functional Group 3 [**3**].

2.2.5 Collaborative Management of Flight Updates

This Element ensures that ATFM has the required flexibility to cope with modifications in departure times, due to traffic changes and operators' preferences. It requires the availability

of precise taxi times provided by Variable Taxi Time Calculation and the CDM Turn-round Process. It is related to Functional Group 4 [**3**].

2.2.6 Collaborative Predeparture Sequence

This Element enhances flexibility and helps in optimising airport resources. It is related to Functional Group 5 [**3**].

2.2.7 CDM in Adverse Conditions

This Element facilitates the dissemination of capacity changes and recovery from disruption, ensuring flexibility and optimum use of available resources. It is related to Functional Group 6 [**3**].

2.2.8 Advanced Concept Elements

These Elements will enhance and extend common situational awareness and increase collaboration between airport partners by utilising advanced technologies and linking with advanced tools, i.e. A-SMGCS, AMAN / DMAN.

The Advanced Concept Elements are still under development and are ex-scope with respect to the current safety assessment. The scope of this safety assessment covers Functional Groups up to FG 6.

2.3 System Assumptions

In conducting the analysis of potential system failures in Section 4 it has been assumed that backwards interference to data sources feeding into ACIS has been guarded against by the design of the data sources. More detailed assumptions have been documented in Appendix I.

3 SUCCESS CASE ANALYSIS

3.1 Overview

The A-CDM project optimises the information flow, decision making and collaboration of partners within an airport. As part of the safety assessment, the safety impacts of A-CDM under normal operating conditions have been analysed as shown in Figure 1.1 under "Success Case". The analysis process involved two safety workshops with A-CDM partners (see Appendix I for participants) and post workshop analysis.

3.2 Analysis by Milestones, Phases and Airport Partners

The main structure for the Success Case analysis was provided by the A-CDM Milestones from the FRD ([3], Section 3.3.8.1). At the beginning of the first safety workshop three other key phases were added, namely "Flight Update Message (FUM) generated by CFMU", "Landing" and "Taxi-out/Departure". The full list of Milestones/ Phases is shown in Table 3.1 below.

Appendix I presents the complete Success Case Analysis. For each phase, the pre-CDM and A-CDM situation is summarised. Based on this the safety implications for each A-CDM partner are identified and documented. Finally potential safety benefits and any potential concerns are summarised.

These summaries of potential benefits and concerns have been copied into Tables 3.1 and 3.2 below, together with appropriate risk mitigators for the concerns.

3.3 Main Outputs

3.3.1 Potential Safety Benefits

The following potential safety benefits of A-CDM covering all conditions have been identified from Table 3.1:

- The timely and increased provision of key information could both improve the situational awareness of all partners and allow them to plan better. In turn these improvements may enhance reaction to unexpected events and reduce the frequency of rushed operations thereby reducing the occurrence of "error-prone" situations.

- Better planned operations may allow workload peaks and troughs to be smoothed and reduce the probability of overload on any of the partner personnel and the probability of RT frequency overload.

- It could lead to better planning of flows of traffic. This may have a particular safety benefit in the case of inbounds and outbounds within airport cul-de-sacs and enhances the traffic planning for runways in mixed mode operation. It could potentially reduce the number of aircraft moving simultaneously in close proximity.

- Better planned operations may reduce the probability of last minute changes. In particular, ground handlers should have fewer occasions where they have to travel across the airport in a hurry to react to an unexpected event.

- Certain A-CDM alarms help identify inconsistencies or other problems in data flows which otherwise may have gone un-noticed.

Although these potential safety benefits were identified by the experts in the safety workshops, it must be stressed that A-CDM is not a “safety tool” and should not be seen as one. Clearly its prime purpose is to improve operational efficiency at an airport. Thus, while the potential safety benefits of A-CDM identified above are valid outputs from the assessment process, they should not be considered “safety measures” as such.

3.3.2 Potential Issues and concerns

The potential issues and concerns in Table 3.2 are:

- Increased potential for Ground Handlers’ unauthorised interference with flight plan data.
- Slight workload increases for certain personnel in entering and updating A-CDM information.

These concerns should be adequately addressed by the following two mitigations:

S1 Service Level Agreements (SLAs) and agreed procedures between Aircraft Operators and Ground Handlers on change access to Flight Plan Information are to be formalised.

S2 Update training and resource needs analysis for all partners. These analyses, which are a typical component of a mature Safety Management System, should cover:
- Review of workload and other demands versus human and other resources;
- Ensuring that training and procedures cover input, receipt and correct use of A-CDM information;
- Ensuring appropriate Human Machine Interface for all users of A-CDM; and
- Updated definition of roles and responsibilities.

Overall, with these mitigations in place, under normal operations A-CDM should not have an adverse impact on safety.

Table 3.1 Analysis of Potential Safety Benefits Under Success Case by Milestones/ Phases (see Appendix I for more details)

Milestones/ Flight Phases	Potential Safety Benefits
MST 1 - Flight Plan Submission	1. Increased transparency in Flight Plan data 2. A-CDM correlation alarms help to identify inconsistencies in flight plan information
MST 2 - ATFM Slot Allocation by CFMU	1. Reduction of workload for Ground Handlers & Airport Operator due to advance availability of flight information 2. Reduction in ATC workload due to better planning in Stand and Gate management
MST 3 - Take off from outstation	1. Reduction of workload for Ground Handlers, Airport Operator and Aircraft Operator due to advance availability of flight information hence reducing probability of making errors 2. Better co-ordination for airport partners allowing better planning and smoother operations
Flight Update Message (FUM) generated by CFMU	1. Enhanced landing estimates coupled with variable taxi times provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload and hence reducing likelihood of errors 2. More accurate information on traffic loading to ATC reducing ATC workload peaks and RT 3. Better aircraft and crew planning for aircraft operators
MST 4 - FIR Entry	1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators 3. More accurate indication of traffic loading for ATC
MST 5 - Final Approach, MST – Landing, MST 6 - Taxi-in period & MST 7 – In Block	1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of errors 2. Better aircraft and crew planning for aircraft operators
MST 8 - Ground handling starts	1. Reduction of Ground Handler's workload if Ground Handling start time is automatically obtained 2. Better estimates on stand/gate vacation leading to potential reduction in errors made by Ground Handler/Airport operator.
MST 9 - Final update of TOBT	1. Reduction of RT loading and workload for ATC 2. Allows better planning for CFMU
MST 10 - ATC issues TSAT	1. Better planning at push-back leading to potential reduction in errors by Ground Handlers and Airport Operator 2. Improved planning of the taxi flow towards the runways enhances the traffic planning for runways in mixed mode operation
MST 11 - Boarding starts	1. Enhanced gate-planning for Airport Operator, potentially reducing errors 2. ATC has advance notice of possible delays enhancing planning
MST 12 - Aircraft ready	1. Enhanced gate-planning for Airport Operator, potentially reducing errors 2. Potential reduction in RT loading for ATC
MST 13 - Start up request & MST 14 - Start up approved	1. Better planning of resources and equipment for Ground Handlers, reducing error likelihood 2. Better stand-gate planning for Airport Operator reducing error likelihood 3. Reduction of frequency congestion for ATC and pilots 4. Better planning and flow of taxi-ing aircraft both inbound and outbound especially in cul-de-sacs
MST 15 - Off Block	1. Better stand-gate planning for Airport Operator reducing error likelihood

Milestones/ Flight Phases	Potential Safety Benefits
Taxi out/Departure & MST 16 - Take off	1. Reduction of enroute sector overloads for ATC 2. Reduction of enroute sector over-deliveries for CFMU due to increased number of aircraft departing within CTOT tolerance window
Adverse conditions CDM	Overall improvement in recovery and management of adverse conditions for all partners, both during and after the event, on a network basis and locally.

Table 3.2 Analysis of Potential Issues and concerns Under Success Case by Milestones/ Phases (see Appendix I for more details)

Milestones/ Flight Phases	Issues and concerns	Mitigation for Concerns	Mitigation Owner
MST 1 - Flight Plan Submission	1. Increased potential for Ground Handlers' unauthorised interference with flight plan data	S1. Service Level Agreements (SLAs) and agreed procedures between Aircraft Operators and Ground Handlers on change access to Flight Plan Information are to be formalised.	Ground Handlers and Aircraft Operator
MST 9 - Final update of TOBT	1. Workload increase for Ground Handlers, and Aircraft Operator in inputting TOBT data and correcting corrupt data	S2. Update training and resource needs analysis.	All partners
MST 10 - ATC issues TSAT	1. Slight workload increase for ATC if DMAN is not present	S2. Update training and resource needs analysis.	ATC
MST 11 - Boarding starts	1. Possible slight increase workload for Ground Handler to resolve boarding alarms 2. Possible slight increase in workload due to recalculation of TSAT by ATC	S2. Update training and resource needs analysis.	All partners

4 FAILURE CASE ANALYSIS

4.1 Overview

In parallel to the analysis of A-CDM during normal operations, an analysis of system failures has also been undertaken as shown in Figure 1.1 “Failure Case”. For this generic analysis, the analysis has been focussed on loss and corruption of information flowing around the A-CDM system. Clearly other failures could be envisaged, e.g. delay of data, data presented out of sequence etc. However, it is typical in a traditional analysis of system failures that by analysing loss and corruption and considering the worst credible effects of the failures, any potential safety impacts will be identified.

4.2 Outputs of Failure Analysis

Table 4.1 summarises the failures from Appendix I that could have a safety impact together with proposed mitigations that should be considered. It should be noted that there are likely to be local specific measures already in place that will act as mitigations for many of these failures. Thus local safety assessments are required to review these generic safety impacts and worst case credible effects. How these local safety assessments should be conducted is further discussed in Section 5.2.

The mitigations (F1 to F4) are procedural and related to equipment system requirements. In many cases high specification equipment system requirements may be unnecessary due to mitigators already built into the local system or due to the proposed procedural mitigations below. Local safety assessments can be used to determine what Software Assurance Levels (SWALs), etc. are appropriate.

4.3 Alarms Failure Case Results

The Failure Case analysis in Appendix I looked at the A-CDM alarms in terms of safety mitigations for certain failures in dataflows. Thus, if key alarms failed to go off the effect of this was considered. However, A-CDM also consists of other alarms that were not directly included in this initial analysis as they are not key safety mitigators. Thus the remaining alarms were also considered in an extra analysis (see Appendix II). Again the worst credible effects due to spurious operation (corruption) of these alarms were identified and documented. In all cases the worst case effects are minor workload increases for relevant partners shown in Appendix II. Thus, equipment system safety requirements will also need to be developed covering spurious operation of these alarms.

Table 4.1 Failure Case Analysis

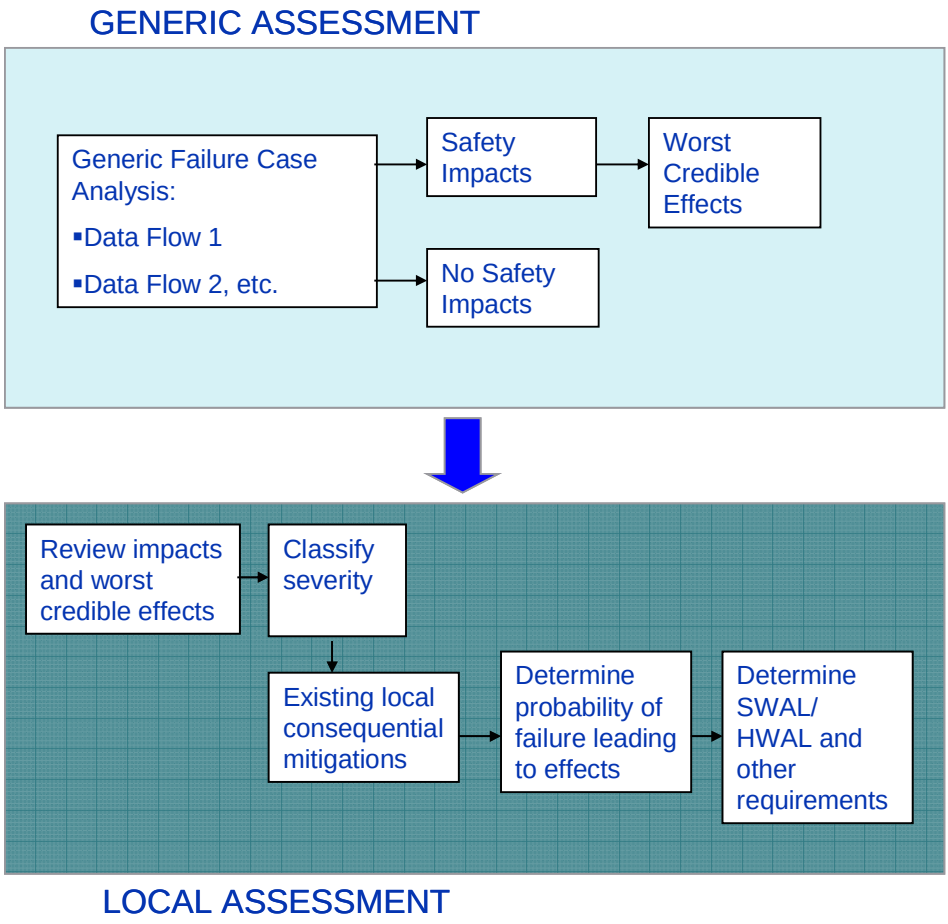
Data Flow/ Item	Failure	Worst Credible Effects	Mitigation	Mitigation Owner
Flight Plan Correlation Failure alarm	This alarm mitigates against various potential flight plan data corruption, e.g. incorrect aircraft type. Thus if it fails to alarm when required, errors may be missed.	Misidentification of aircraft type, for example, could lead to inappropriate stand allocation or wake turbulence spacing	F1a: Equipment system requirement	Equipment system designer
TOBT	Corrupted TOBT	Start-up based on corrupted TOBT requiring ATC to resolve downstream, workload increase	F1b: Equipment system requirement F2: Procedure for EOBT/ TOBT originators to review these data and correct if corrupted.	Equipment system designer Ground Handler/Airport Operator
EXOT	Corruption of EXOT	Departure outside CTOT tolerance, increasing ATC workload	F1c: Equipment system requirement	Equipment system designer
TTOT	Corruption of TTOT	Departure outside CTOT tolerance, increasing ATC workload	F1d: Equipment system requirement	Equipment system designer
Default Turn Around Time	Corruption of Default Turn Around Time	Sub-optimum sequencing, increasing ATC workload	F3: Ground handlers to update turn-around time on CDM system if system indicates deviation by more than +/- 15 mins.	Ground Handler
TSAT	Loss or corruption of TSAT	Potential for aircraft starting at incorrect times	F4: ATC to cross-check EOBT and CTOT information before issuing startup instructions based on TSAT.	ATC

5 LOCAL ASSESSMENT

The Failure Case analysis has identified a limited number of data flows/ items which could have a safety impact if failures should occur. Appropriate equipment system requirements and procedures should adequately mitigate their risk. Deciding on what exactly is appropriate will require local safety assessments as described below.

Figure 5.1 summarises how the local A-CDM failure analysis can make use of the generic analysis summarised in Section 4 above.

Figure 5.1 Generic and Local Failure Case Analysis



The generic analysis has made an initial identification of those data flows/ items which could have a safety impact if failure occurs. Based on this screening, the worst credible effects of safety related failures have also been identified.

It is proposed that local assessments build on this generic way in the following manner:

1. Review whether in the local situation under study, failures of each A-CDM data flow would indeed have safety impacts (see Appendix I, sections 1-5, last column, for predicted safety impacts on each airport partner). If failures do have local safety impacts, review whether the worst credible effects from the generic study (Table 4.1) are appropriate.

2. For those failures with local safety impacts classify the severity of the effects. Severity classes and examples of effects corresponding to these classes are given in ESARR4 [**5**].

3. Identify, analyse and document all the mitigations that will reduce the probability of the failure leading to the worst credible effects (consequential mitigations). These mitigations could include, for example, ATC procedures, other systems for transferring and displaying information, training given to airport partners etc.

4. Taking account of all these mitigations and local airport factors (e.g. traffic density/ complexity) estimate the probability of the failure leading to the identified effects. The EUROCONTROL Safety Assessment Methodology [**6**] gives guidance about probability estimation in the context of SWAL allocation. The growth of future traffic needs to be considered in this process as the system needs to be safe throughout its intended life.

5. Use EUROCONTROL SAM guidance [**6**] or equivalent industry guidance to determine suitable equipment system safety requirements. For Software Assurance Levels (SWAL) the SAM shows a matrix of effect severity classes and the probability of a failure generating those effects to identify which SWAL is required.

The 5 step approach above is a simplified description of the Assurance Level allocation process; for a more detailed description EUROCONTROL's SAM **[6]** should be consulted.

6 VALIDATION AND VERIFICATION

The following verification activities have been conducted during this safety assessment:

- Review of Safety Plan describing safety assessment activities to be carried out by EUROCONTROL's APR stakeholders and DAP/SSH (2 review cycles)
- Internal APR Progress meetings at which updates to the method were discussed and agreed with EUROCONTROL's APR stakeholders and DAP/SSH (28th February, 22nd June and 10th August 2006)
- External stakeholder meetings at which the method was presented and feedback received (16th June and 7th September 2006)
- Review of safety assessment document structure and of the draft safety assessment report by EUROCONTROL's APR stakeholders and DAP/SSH.

The following validation has also been carried out:

- Review of safety assessment outputs by internal and external stakeholders at 2 safety workshops, 16th June and 7th September 2006.
- Review by APR stakeholders of the outputs in Appendix I of this report (2 review cycles)
- Review of outputs by DAP/SSH at these workshops and through review of the draft safety assessment.

7 CONCLUSIONS

The three objectives set out in section 1.2 have been met, namely:

1. The operational differences between pre and post A-CDM operations have been defined for all partners and flight phases in Appendix I.
2. The safety impacts of the operational differences for the Success Case and Failure Case have been assessed in Appendix I and summarised in sections 3 and 4 above respectively.
3. For potential issues and concerns and new hazards, suitable mitigations have been defined in sections 3 and 4.

This generic safety assessment concludes that A-CDM will lead to no adverse safety impacts with the mitigations identified in this report.

A very limited number of potential safety concerns have been identified. The Success Case issues would be adequately mitigated by practicable procedural and Safety Management System (SMS) recommendations which have been proposed. In particular clear definitions of roles and responsibilities are required to ensure that all relevant personnel understand how A-CDM information is to be used. The Failure Case issues are mostly adequately mitigated by practicable procedural recommendations. In addition, there may be a need for some system equipment requirements (e.g. Software Assurance Level) for certain data items within A-CDM. An initial set of key data items has been identified in this generic study which local assessments would need to check to determine if system equipment requirements are needed, or whether failure effects are adequately mitigated by other means.

8 REFERENCES

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2. EUROCONTROL (2005): “Airport CDM Operational Concept Document”, Edition 2.0, October 2005
3. EUROCONTROL (2005): “Airport CDM Functional Requirements Document”, Edition 2.0, October 2005
4. EUROCONTROL (2006): “Safety Plan for 3 Airports Projects (ACE, A-CDM and RWY SAF)”, Edition 1.0, May 2006
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6. EUROCONTROL (2006): “SAM Electronic – PSSA v2.0 Guidance Chapter 3 Guidance A”, 2006

APPENDIX I – A-CDM SUCCESS AND FAILURE CASE RESULTS

The analysis presented in this appendix is based on a series of safety workshops and post-workshop analysis. The participants in this process are detailed in the Table below together with the organisation they were representing. Two main workshops were held with EUROCONTROL and external stakeholders and the participation in each is indicated below.

Name	Role/ Organisation	External 1	External 2
Elizabeth Lagios	CDM Project Manager, EUROCONTROL	✓	✓
Zarko Sivcev**	CFMU Safety and Quality Manager, EUROCONTROL	✓	✓
Dave Hogg**	Airport CDM Project Expert, EUROCONTROL	✓	✓
David Booth*	CDM Project Expert, EUROCONTROL	✓	✓
Marc Matthys**	Capacity, CDM and Punctuality, Belgocontrol	✓	✓
Luigi Locoge	ATCO, Belgocontrol	✓	
Albert Coenan	Air Traffic Flow Manager, SN Brussels Airlines	✓	✓
Christopher Machin	DAP/SSH, EUROCONTROL	✓	✓
Edward Smith*	DNV, Facilitator		✓
Roger Lee*	DNV, Recorder/ Facilitator	✓	✓

*** Main post-workshop analysis**
**** Main reviewers**

The spreadsheet below details the outputs from the workshops and post-workshop analysis. Potential safety benefits of A-CDM are indicated by "+" and potential issues and concerns by "-". The analysis is presented for each of the following partners in turn: Ground Handler (green columns), Airport Operator (light blue columns), Aircraft Operator (orange columns), ATC (purple columns), and CFMU (blue columns). Finally the assessment and proposed mitigations are summarised. It should be noted that the explicit impact on pilots is not included. Clearly many of the impacts will also benefit pilot, e.g. reduced RT at start-up, but these have not been described explicitly for each milestone and flight phase.

1. Ground Handler

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	All Ground Handlers now have direct access to flight plan information	**In standard operations:** (+) Increased transparency on relevant changes (EOBT, Aircraft Type, Aircraft Reg) to flight plan (-) Interference from handling agent on ATC flight plan and hence probability of error occurrence increased. Mitigated by SLAs and procedures
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from CFMU to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	All Ground Handlers get direct access to Slot Allocation Information	**In standard operations:** (+) No need to look for the Slot Allocation Message or ask other partners for messages. Workload reduction resulting in more time to verify other safety critical activities
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	Movement messages readily available	**In standard operations:** (+) No need to look for the MVT message or ask other partners for messages. Workload reduction resulting in more time to verify other safety critical activities
Flight Update Message (FUM) generated by CFMU	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5	Enhanced landing estimate, coupled with variable taxi	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Alarm		mins incurred en-route will generate new message. Message will be received by one partner on the airport and will be input into the ACIS.	times will give more accurate In Block time	hitting equipment
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	Direct access of the FIR Entry information translated into updated ETAs	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft hitting equipment
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	Direct access of the Start Approach information translated into updated ETAs	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft hitting equipment
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	Direct access of the landing time information translated into updated In Block time	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft hitting equipment
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	Using the variable taxi-times facility in CDM, more accurate In Block time will be available	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft hitting equipment
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	No change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT	Ground Handler to input AGHT into ACISP. Ground Handler may manually input update of TOBT	**In standard operations:** (+) If ground handling start is automatic at AIBT then Ground Handler's workload may be reduced. (-) If Ground Handler has to input ground handling start time manually workload may increase slightly
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	Submit TOBT to all partners	**In standard operations:** (-) Workload increased **In failure circumstances:** (-) Should the information displayed be corrupted, Ground Handler would be required to manually correct this on the ACIS system to avoid aircraft startup/takeoff outside CTOT tolerance, increase in workload
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	Visibility of TSAT information	**In standard operations:** (+) Better planning of resources and equipment reducing the risk of ground incidents
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the	If a boarding alarm is raised the ground handler will be	**In standard operations:** (-) Possible slight increase in workload

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
			TOBT/ TSAT may not be met.	required to resolve the discrepancy	
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	No change	No change
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	Ground handlers will have access to TSAT and this will enable them to plan their push back resources better	**In standard operations:** (+) Better planning of resources and equipment reducing the risk of ground incidents
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	No Change	No Change
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	No Change	No Change
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT	Aircraft taxis to holding point. Default taxi time available to ATC and CFMU	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	No change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Compliance Alarm, Flight Suspension Alarm				
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	No change	No Change
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

2. Airport Operator

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	No Change	No Change
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from CFMU to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	Better visibility of slot information	**In standard operations:** (+) Airport operator workload may reduce as a result of better planning
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	Movement messages readily available	**In standard operations:** (+) No need to look for the MVT message or ask other partners for messages. Workload reduction resulting in more time to verify other safety critical activities
Flight Update Message (FUM) generated by CFMU	EET, Capacity Information, Flow Management Attribute,	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will	Enhanced landing estimate, coupled with variable taxi times will give more accurate In Block time	**In standard operations:** (+) Better planning can result in enhanced stand-gate

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Regulation Cancelled Alarm		generate new message. Message will be received by one partner on the airport and will be input into the ACIS.		planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	Direct access of the FIR Entry information translated into updated ETAs	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	Direct access of the Start Approach information translated into updated ETAs	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	Direct access of the landing Time information translated into updated In Block time	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
					reducing mistakes being made
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	Using the variable taxi-times facility in CDM, more accurate In Block time will be available	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	No Change	No Change
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT	Airport Operator will have direct access to AGHT and any updates to TOBT	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	Visibility of TOBT information	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes,

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Alarm				reduction in stressful situations & hence reducing mistakes being made
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	Visibility of TSAT information	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	Earlier warning of possible delay to departing flight.	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	**In standard operations:** (+) Stand & Gate planning may improve as the opportunity to tow aircraft off stand or utilise remote holding facilities increases due to advance display of aircraft status

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	Stand & gate management will know the precise time that an aircraft will leave the stand	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	No Change	No Change
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	Stand & gate management will know the precise time that an aircraft has left the stand	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled	Aircraft taxis to holding point. Default taxi time available to ATC and CFMU	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Alarm, CTOT Compliance Alarm, Flight Suspension Alarm				
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	No Change	No Change
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

3. Aircraft Operator

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	No Change	No Change
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from CFMU to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	No Change	No Change
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	Movement messages readily available	**In standard operations:** (+) No need to look for the MVT message or ask other partners for messages. Workload reduction resulting in more time to verify other safety critical activities
Flight Update Message (FUM) generated by CFMU	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled Alarm	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message.	Enhanced landing estimate which coupled with variable taxi times will give more accurate In Block time	**In standard operations:** (+) Better aircraft and crew planning

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
			Message will be received by one partner on the airport and will be input into the ACIS.		
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	Direct access of the FIR Entry information translated into updated ETAs	**In standard operations:** (+) Better aircraft and crew planning
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	Direct access of the Start Approach information translated into updated ETAs	**In standard operations:** (+) Better aircraft and crew planning
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	Direct access of the landing Time information translated into updated In Block time	**In standard operations:** (+) Better aircraft and crew planning
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	Using the variable taxi-times facility in CDM, more accurate In Block time will be available	**In standard operations:** (+) Better aircraft and crew planning
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	Remote AOCs will have access to ACISP	No Change
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	Submit TOBT to all partners	**In standard operations:** (-) Workload increased **In failure circumstances:** (-) Should the information displayed be corrupted, Airport Operator would be required to manually correct this on the ACIS system to avoid aircraft startup/takeoff outside CTOT tolerance, increase in workload
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	Visibility of TSAT information	**In standard operations:** Enhanced information but no foreseeable safety change
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	Earlier warning of possible delay to departing flight.	No Change
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	More automated indication of aircraft readiness via the milestone process	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
				and transparency in ACIS	
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	No Change	No Change
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	No Change	No Change
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	Earlier notification of actual push back especially with non ACARS equipped aircraft	No Change
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT Compliance Alarm, Flight Suspension Alarm	Aircraft taxis to holding point. Default taxi time available to ATC and CFMU	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	Earlier indication of estimated take off time	No Change
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
			available to all partners.		
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

4. ATC

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	No Change	**In failure circumstances:** (+) If credible corruption of flight plan modification message occurs, CDM correlation alarm will mitigate risk.
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from CFMU to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	Better visibility of slot information	**In standard operations:** (+) ATC workload may reduce as a result of better planning in stand and gate management by other partners.
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	No Significant Change	**In standard operations:** (+) Better co-ordination for Airport Partners resulting in better planning
Flight Update Message (FUM) generated by CFMU	EET, Capacity Information, Flow Management Attribute, Regulation	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will	No Significant Change	**In standard operations:** (+) More information on when aircraft is active, reducing workload and RT.

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Cancelled Alarm		generate new message. Message will be received by one partner on the airport and will be input into the ACIS.		
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	No Change	No Change
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	No Change	No Change
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	No Change	No Change
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	No Change	No change as assumed that separate ATC systems already display Stand and Gate Allocation and WIP
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	No Change	No Change
MST 8 - Ground	EOBT, TTOT, Default Turn	Ground Handling event starts and time is	Actual Start of Ground Handling Time input into	EOBT information is	**In failure circumstances:** (-) Corrupted Default Turn Around Time can

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
handling starts	Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	recorded by Ground Handler but not generally disseminated to other partners	ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT and TTOT	displayed in ACIS and ATC displays simultaneously.	generate a corrupted EOBT, this is a safe but sub-optimum sequence which might need ATC to resolve therefore increasing ATC workload.
MST 9 - Final update of TOBT	TOBT, TTOT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	TOBT available	**In standard operations:** (+) More information on when aircraft is active, reducing workload and RT. **In failure circumstances:** (-) If TOBT is credibly corrupted, startup clearance could be based on corrupted TOBT information, requiring ATC to resolve downstream, workload increase
MST 10 - ATC issues TSAT	TSAT, TTOT, ETOT, EOBT Compliance Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	No change - auto generated	**In standard operations:** (+) Improved planning of the taxi flow towards the runways enhances the traffic planning for runways in mixed mode operation (-) If DMAN is not present this might be performed manually hence more workload **In failure circumstances:** (-) Aircraft could be started at incorrect time if TSAT information is credibly corrupted (-) If TTOT is credibly corrupted on ACIS, ATC might instruct aircraft to takeoff outside CTOT tolerance time.
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	Earlier warning of possible delay to departing flight which may result in revised TOBT	**In standard operations:** (+) Advance notification of possible delays (-) Possible slight increase in workload due to recalculation of TSAT
MST 12 -	Regulation	If aircraft is ready well	More automated	Using	**In standard operations:**

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
Aircraft ready	Cancelled Alarm	before CTOT, pilot will advise ATC and request a slot improvement	indication of aircraft readiness via the milestone process and transparency in ACIS	milestone process ATC have a better guarantee of aircraft readiness	(+) Potential reduction in R/T as aircraft should not declare readiness when they are not
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	Aircraft requests start up approval from ATC at TSAT	**In standard operations:** (+) Decrease in frequency congestion as pilot requests start up clearance at a specified time. Better planning and flow of taxi-ing aircraft both inbound and outbound especially in cul-de-sacs
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	EXOT, TTOT times are now available on ACIS display.	**In failure circumstances:** (-) Credibly corrupted EXOT might lead to credibly corrupted TTOT, causing aircraft to depart outside CTOT. ATC needs to resolve this, hence increasing workload
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	No change	No change as assumed that separate ATC systems already display Stand and Gate Allocation
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take	Aircraft taxis to holding point. Default taxi time available to ATC and CFMU	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	More accurate estimated take off times give better CTOT compliance	**In standard operations:** (+) Better CTOT compliance reduces the risk of en route sector overloads

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT Compliance Alarm, Flight Suspension Alarm				
MST 16 - Take off	ATOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	No change	No change as assumed that separate ATC systems already display Runway in Use
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

5. CFMU

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	No Change	No Change
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from CFMU to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	No Change	No Change
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	No Change	No Change
Flight Update Message (FUM) generated by CFMU	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled Alarm	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message. Message will be received by one partner on the airport and will be input into the ACIS.	No Change in workload. Message will be issued automatically.	No Change
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from	All partners will be informed of FIR entry and more accurate arrival times	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
		ATC			
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	No Change	No Change
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	No Change	No Change
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	No Change	No Change
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	No Change	No Change
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT	No Change	No Change
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	CFMU will receive more accurate EOBT	**In standard operations:** (+) Better planning, more accurate information
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance	Dissemination of TSAT procedure currently does not	ATC provides all partners with TSAT information	CFMU gets EOBT AND ETOT update via DPI	**In standard operations:**

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	exist		messages	(+) Better planning, more accurate information
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	Possible update of EOBT and ETOT via DPI message	No Change
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	No Change	No Change
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	No Change	No Change
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	No Change	No Change
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	No Change	No Change
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway	Aircraft taxis to holding point. Default taxi time available to ATC and CFMU	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	More accurate estimated take off times contribute to better monitoring of the CTOT compliance and, if	**In standard operations:** (+) Better CTOT compliance reduces the risk of en route sector

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT Compliance Alarm, Flight Suspension Alarm			necessary, trigger appropriate warning messages to ensure CTOT is adhered to.	over-deliveries
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	No Change	No Change
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

Success Case Safety Assessment Summary and Mitigations identified

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	**Potential safety benefits:** 1. Increased Transparency in Flight Plan data 2. Correlation Alarms help to identify inconsistencies **Issues and concerns in Normal Operating Conditions:** 1. Probability of increase in Ground Handlers' unauthorised interference with flight plan data	**In standard operations:** 1. Service Level Agreements (SLAs) and agreed procedures with Ground Handlers on change access to Flight Plan Information are to be formalised. **In failure circumstances:** 1. Safety requirements on loss and corruption of Flight Plan Correlation Failure alarms to be generated
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from CFMU to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	**Potential safety benefits:** 1. Reduction of workload for Ground Handlers & Airport Operator due to advance availability of flight information 2. Reduction in ATC workload due to better planning in Stand and Gate management	
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	**Potential safety benefits:** 1. Reduction of workload for Ground Handlers, Airport Operator and Aircraft Operator due to advance availability of flight information hence reducing probability of making errors 2. Better co-ordination for ATC with partners allowing better planning and smoother ops	

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
Flight Update Message (FUM) generated by CFMU	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled Alarm	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message. Message will be received by one partner on the airport and will be input into the ACIS.	**Potential safety benefits:** 1. Enhanced landing estimates coupled with variable taxi times provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload and hence reducing likelihood of mistakes and ground incidents 2. More accurate information on traffic loading to ATC reducing ATC workload and RT 3. Better aircraft and crew planning for aircraft operators.	
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	**Potential safety benefits:** 1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators 3. More accurate indication of traffic loading for ATC **No Issues or concerns identified.**	
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	**Potential safety benefits:** 1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators **No Issues or concerns identified.**	
MST -	EIBT	ATC record	All partners will	**Potential safety benefits:**	

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
Landing		landing time on Flight Progress Strip, all partners might not be disseminated with this information	have actual landing times	1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators	
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	**Potential safety benefits:** 1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators	
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	**No Potential safety benefits identified.**	
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance	Ground Handling event starts and time is recorded by Ground Handler but not generally	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream	**Potential safety benefits:** 1. Reduction of Ground Handler's workload if Ground Handling start time is automatically obtained 2. Better estimates on stand/gate vacation leading to reduced stress/workload and potential reduction in error made by Ground	**In standard operations:** 1. Update Training and Resource Needs Analysis **In failure circumstances:** 1. Ground handlers to update turn-around time on

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
	Alarm	disseminated to other partners	events e.g. automatic update of TOBT	Handler/Airport operator. **Issues and concerns under normal operating conditions:** 1. Slight workload increase for Ground handler if need to input Ground Handling time manually **Issues and concerns under failure conditions:** 1. Corruption of default turn around time can lead to sub-optimum sequencing, increasing ATC workload.	CDM system if system indicates deviation by more than +/- 15 mins.
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	**Potential safety benefits:** 1. Better estimates on stand/gate vacation leading to reduced stress/workload and reduction in error made by Airport operator. 2. Reduction of RT loading and workload for ATC 3. Allows better planning for CFMU **Issues and concerns under normal operating conditions:** 1. Slight workload increase for Ground Handlers and Airport Operator in inputting TOBT data and correcting corrupt data **Issues and concerns under failure conditions:** 1. If TOBT is credibly corrupted, startup clearance could be based on corrupted TOBT information, requiring ATC to resolve downstream, workload increase	**In standard operations:** 1. Update Training and Resource Needs Analysis **In failure circumstances:** 1a. EOBT/TOBT originators shall review the displayed EOBT/TOBT entry and correct if corrupted. 1b. Loss and Corruption Systems Requirement for TOBT to be generated
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight	Dissemination of TSAT procedure currently does	ATC provides all partners with TSAT information	**Potential safety benefits:** 1. Better planning at push-back reducing stress, workload and errors made by Ground Handlers and Airport Operator	**In failure circumstances:** 1. ATC to cross-check EOBT and CTOT information before issuing

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
	Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	not exist		2. Improved planning of the taxi flow towards the runways enhances the traffic planning for runways in mixed mode operation **Issues and concerns under normal operating conditions:** 1. More workload for ATC if DMAN and AMAN are not present **Issues and concerns under failure conditions:** 1. Potential increase in ATC RT workload if TSAT is lost and potential for aircraft starting at incorrect times under corruption of TSAT 2. TTOT corruption has the potential to cause aircraft takeoff outside CTOT tolerance, increasing ATC workload	startup instructions based on TSAT. 2. Safety requirements for corruption of TTOT shall be generated.
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	**Potential safety benefits:** 1. Enhanced gate-planning for Airport Operator, potentially reducing errors 2. ATC has advance notice of possible delays enhancing planning **Issues and concerns in normal operating conditions:** 1. Possible slight increase workload for Ground Handler to resolve boarding alarms 2. Possible slight increase in workload due to recalculation of TSAT by ATC **No Issues or concerns in failure conditions identified**	**In standard operations:** 1&2. Update Training and Resource Needs Analysis
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and	More automated indication of aircraft readiness via the milestone process and	**Potential safety benefits** : 1. Enhanced gate-planning for Airport Operator, potentially reducing errors 2. Potential reduction in RT loading for ATC	

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
		request a slot improvement	transparency in ACIS	**No issues or concerns identified.**	
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	**Potential safety benefits:** 1. Better planning of resources and equipment for Ground Handlers, reducing risks of ground incidents 2. Better stand-gate planning for Airport Operator reducing errors made 3. Reduction of frequency congestion for ATC and pilots 4. Better planning and flow of taxi-ing aircraft both inbound and outbound especially in cul-de-sacs	
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	**No significant safety benefit has been identified** **Issues and concerns under failure conditions:** 1. Corruption of EXOT may lead to aircraft to depart outside CTOT, increasing workload for ATC.	**In failure circumstances:** 1. Safety requirements on loss and corruption of EXOT data
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	**Potential safety benefits :** 1. Better stand-gate planning for Airport Operator reducing errors made	

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
		disseminated among all partners			
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT Compliance Alarm, Flight Suspension Alarm	Aircraft taxis to holding point. Default taxi time available to ATC and CFMU	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	**Potential safety benefits:** 1. Reduction of enroute sector overloads for ATC 2. Reduction of enroute sector over-deliveries for CFMU	
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	**No significant potential safety benefits identified**	
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	No consensus from experts concerning potential potential safety benefits.	

APPENDIX II – A-CDM ALARMS SAFETY ASSESSMENT

Alarm	Flight Phase	Worst Credible Effects under failure condition	Proposed Mitigation
CFMU Error Alarm	Alarm has been removed from specification		
Flight Plan Correlation Failure Alarm	MST 1 - Flight Plan Submission	Possible minor workload increase for airline operator and ATC under corruption.	System Safety Requirement
Regulation Cancelled Alarm	• MST 2- **ATFM** Slot Allocation, • FUM generated by CFMU • MST 9 - Final updates of TOBT • MST 12 - Aircraft ready • MST 14 - Start-up approved • Departure • MST-16 Takeoff	Possible minor workload increase for ground handler, airport operator, airline operator and ATC under corruption.	System Safety Requirement
Airborne Alarm	MST 3 - Takeoff from outstation	Possible minor workload increase for ground handler, airport operator, airline operator and ATC under corruption.	System Safety Requirement
Minimum Turn-around Alarm	• MST 8 – Ground Handling Starts • MST 9 – Final Update of TOBT • MST 11- Boarding Starts	Possible minor workload increase for ground handler and airline operator under corruption.	System Safety Requirement
Boarding Alarm	MST 11 - Boarding Starts	Possible minor workload increase for ground handler, airline operator and airport operator under corruption.	System Safety Requirement
EOBT Compliance Alarm	• MST 8 – Ground Handling Starts • MST 9 – Final Update of TOBT • MST 10- ATC Issues TSAT • MST 11- Boarding Starts	Possible minor workload increase for ground handler, airline operator, airport operator and ATC under corruption.	System Safety Requirement
TOBT Confirmation missing	To be removed from manual		

Alarm	Flight Phase	Worst Credible Effects under failure condition	Proposed Mitigation
CTOT Compliance Alarm	Departure	Possible minor workload increase for ground handler, airline operator, airport operator and ATC under corruption.	System Safety Requirement
Flight Plan Already Correlated	MST 1 - Flight Plan Submission	Corruption: • Possible minor workload increase for ground handler, airline operator, airport operator and ATC under corruption.	System Safety Requirement
Flight Plan/Schedule Discrepancy Alarm	MST 1 - Flight Plan Submission	Possible minor workload increase for ground handle and airport operator under corruption.	System Safety Requirement
Flight Schedule Cancellation Alarm	Alarm deleted from the manual		
Flight Plan Cancellation Alarm	• MST 4 – FIR Entry • MST 10 – ATC issues TSAT	Possible minor workload increase for ground handler, airline operator, airport operator and ATC under corruption.	System Safety Requirement
Flight Suspension Alarm	• MST 10 – ATC issues TSAT • MST-13 Start-up Request • Departure	Possible minor workload increase for ground handler, airline operator, airport operator and ATC and CFMU under corruption	System Safety Requirement
Flight De-Suspended Alarm	• MST 10 – ATC issues TSAT • MST-13 Start-up Request • Departure	Possible minor workload increase for ground handler, airline operator, airport operator and ATC and CFMU under corruption	System Safety Requirement